

Comparative study for the removal of crystal violet from aqueous solution by natural biomass adsorbents of a pinecone, cypress, and oak: kinetics, thermodynamics, and isotherms

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ABSTRACT

In this study, natural and available biomass of a raw pinecone (P), cypress fruit (C), and oak cupule (O) powders were used as adsorbents for the removal of crystal violet (CV) from aqueous solution. Techniques of FT-IR, SEM, and XRD were employed for the characterization of biomass materials before (P, C, and O) and after adsorption (PCV, CCV, and OCV). Results show that the adsorption capacity of CV is influenced by parameters of dosage, particle size, initial concentration, contact time, pH, and temperature. The best uptake of CV ranged between 80.64 and 105.24 mg/g by P, C, and O under optimal conditions of: 0.07 g O, and 0.05 g P and C, 60 mg/L initial concentration of CV, 80 min. Contact time for O, and 100 min. for C and O, pH 7.0 for P, and pH 9.0 for C and O. The fit to the pseudo-second-order kinetics model suggests chemical adsorption onto P adsorbent. While the fit to pseudo-first-order kinetic model suggests physical adsorption onto C and O adsorbents. The Langmuir isotherm model fitted the experimental data with a maximum adsorption capacity of 80.84, 105.24, and 90.91 mg/g by P, C, and O, respectively. The study revealed that low-cost and eco-friendly biomasses of P, C, and O posed a very good potential as adsorbents for CV dye removal.

Keywords: Adsorption; Crystal violet (CV); Natural biomass; Pinecone; Oak; Cypress

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